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Threatened fishes of the Szigetköz

by
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Abstract: Szigetköz, a section of the Danube river system, represents many water types found in Hungary. 65 of the 80 fish species native to Hungary have been reported from this territory, being thus the richest region considering species number.
Key words: river ecological indicators, fish fauna, changing environment, river regulation, hydropower dams, threatened species, Szigetköz

Introduction

The section of the Danube river system called "Szigetköz" (Fig. 1), which was originally a side arm system, represents many water-types found in Hungary. Out of the 80 native fish species of Hungary 65 have been recorded in this territory (Vida 1990a, 1990b). There is no other region of the country with comparable species-richness. 30 percent of the fish species is considered as stenoecious, in other words they are restricted to certain specific aquatic habitat types.

The water bodies of the Szigetköz can be classified into six main hydrogeographical categories, as follows (Vida 1990a, 1990b):

- main channel;
- connected backwaters (side river-branch system of the flood plain);
- irrigation channels outside the flood plain;
- backwaters of the flood free area;
- ponds of gravel-pits;
- Mosoni-Duna, which is a side arm of the main channel.

Methods and material

The selection of the fish sampling sites was based on the following aspects:

- sampling of the whole geographic area should be done;
- including all the water types;
- inclusion of sites with special circumstances; sites of our former collections;
- partial overlapping with previous sampling sites of other hydrobiological studies.

The applied fishing methods were as follows:

- electric research fishing-machine;
- framed fry-catcher;
- seines, with different mesh-size;
- drift-nets, with different mesh-size;
- lift-nets.

These combined methods provided an effective sampling. Our results therefore differ considerably from the capture data of the local fishermen of the different age groups of fishes throughout the whole study area.

Experimental fishing in all water types took place in every season annually, from 1986 to 1993, with a total of 187 collecting days. Number of sampling localities according to the different hydrogeographical categories:

- main channel, 14 sampling points;
- flood plain, 120 sampling points;
- irrigation channels outside of the flood plain, 8 sampling points;
- backwaters of the flood free area, 12 sampling points;
- ponds of gravel-pits; no sample;
- Mosoni-Duna, 6 sampling points.

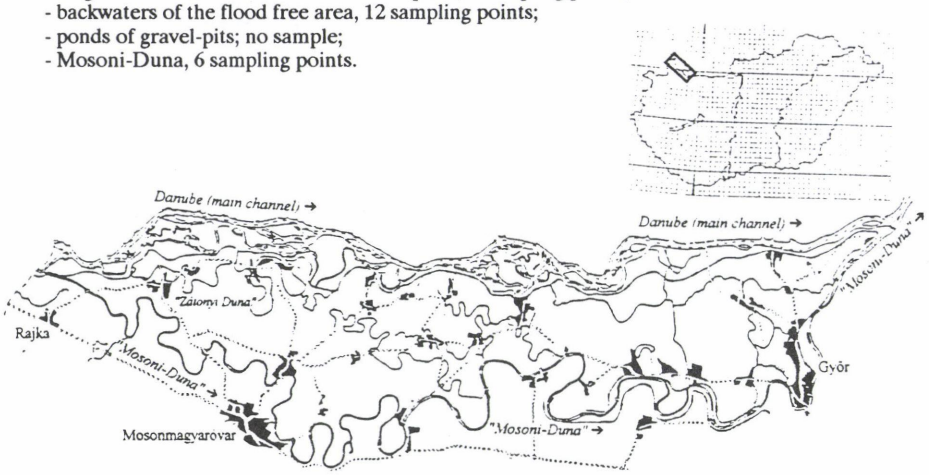

Fig. 1. Location of the Szigetköz

Results

The area has been classified by Balon (1964) as a "sub-montane zone". He studied the fish fauna of this zone thoroughly, including all branches of the river. His ecological categories are based on both physical (e.g. water current) and biotic (fish fauna) characteristics. In his opinion, the "sub-montane" zone extends between 2000 and 1650 riverkilometers. The Szigetköz section of the river ranges from 1850 to 1794 riverkms.

Holčik *et al.* (1981) published hydrobiological and ichthyological investigations in connection with the planned Gabčikovo-Nagymaros hydroelectric power system. They listed 66 fish species from the Slovakian side of Danube, from which 4 can be denied for various reasons:

- *Eudontomyzon vladykovi* is identical (synonymous) with *Eudontomyzon danfordi*, also included in the list;
- *Barbus meridionalis petenyi,* which can only be found west of the Danube-Bend (Visegrád-Esztergom) in "Pilis-Hills";
- *Salvelinus fontinalis* and
- *Micropterus salmoides* which have not been found in the last 20 years.

For similar reasons the presence of *Acipenser gueldenstaedti* in this area seems to be dubious, though its accidental occurrence in the future cannot be excluded. Eventhough the area is included in this species' range on the distribution map published by Vlasenko *et al.* (1989), they indicate that no records are known since 1902.

The study of the Hungarian side (Jancsó & Tóth 1987) gave a list of all indigenous species of *Acipenseridae,* including very early literature data. *Micropterus*

salmoides is mentioned here, too. The co-occurrence of the two subspecies of *Cobitis (Sabanejewia) aurata* (i.e. *ssp. balcanica* and *bulgarica)* is also reported. Since there is no obvious geographical isolation in the habitats of the two subspecies, their sympatric coexistence is questionable. *Gymnocephalus baloni*, *Gobio albipinnatus* and *Eudontomyzon mariae* are not mentioned in their list.

The main channel

This is the 56 km long navigation line of the Danube, with artificial shore lines (rock fills). The frontier between Hungary and Slovakia is the main axis of the flow in the river (Thalweg). The channel gradient is the highest here in the Hungarian part of the Danube: the elevation is reduced by 19 m in 56 km.

The running water of the upper part of the main channel, having increased water velocity up to 2 m/s, is the habitat of many rheophilous species that are otherwise very rare in Hungary because of the absence of similar conditions. That is the reason why the Szigetköz area is so precious for Hungarian ichthyologists. The moderately rheophilous species can only find suitable conditions downstream of the groins (transverse rode-fills) and behind the moving banks. Occasionally species characteristic to the connected backwaters also turn up here. This is also the main route of migratory fishes. Consequently, the number of fish species in the main river is extremely high (57) as compared with other water bodies in Hungary (see Table 1).

Many of these are known to live exclusively here in the country (e.g. *Hucho h. hucho*). This is one of the rarest endemic species of the Danube System. This migratory salmonid fish has a very broad ecological tolerance. Natural reproduction of *Hucho h. hucho* in the Hungarian Danube cannot be excluded, but unfortunately, it is more probable that occasional catches of this species originated from artificial fry releases in Austria or Slovakia. According to Holčik (1982), this species migrates only 10 to 30 km following its prey populations. Since the river upstream the Danube-Bend is rich in *Chondrostoma nasus*, the main prey of *Hucho h. hucho*, the suitable habitat is available. Nevertheless, its protection is necessary. A ban to catch any salmonid fish in the river would be the first step towards conservation.

Another species, *Cottus gobio,* was reported in the 1960s from the Danube-Bend between Vác and Verőcemaros (Botta pers. comm.). There was no other natural habitat known of this species in Hungary. In our study between 1989-1992 an abundant *Cottus gobio* population was observed along the elevated current sides of the river. According to the literature (Lelek 1987), this species is generally regarded as characteristic for the salmonid zone. Straškraba *et al.* (1966) have shown that competition between *Cottus gobio* and the brown trout is almost negligible despite earlier reports. The reproductive biology of *Cottus gobio* populations and their role in the food web have not been studied in Hungary so far.

The side arm system of the flood plain area

The 6000 ha area between the main channel and the flood-control dike in Szigetköz includes 77 river branches with a total length of 137 km. They belong to the five respective side arm systems, as follows:

- Side Arm System (SAS) of Tejfalusziget;
- SAS of Cikolasziget;
- Double SAS of Bodak-Dunaremete;

- SAS of Ásvány;
- SAS of Bagamér.

These channels may function as natural water purification areas for the river in case of active water exchange between the main channel and the side arms. The system is filled up with allochtonous organic and mineral matter during high flood condition. As the flood peak passes and the direct communication disappears the flow velocity and the turbulence of the water decreases. Then, a series of physical, chemical and biological processes will result in a considerable eutrophication process. Because of the difference in the available water supply (i.e. bank filtration) the quality of the individual water bodies can vary in a broad scale. Extreme conditions might occur that only certain fish species can usually tolerate (e.g. *Misgurnus fossilis, Carassius carassius*).

The low-water of winter months is usually followed by medium or high levels due to the snow melting in the Alps (the so-called "icy-flood"). This is the main spawning-season for the species of this area. Most of the fishes of the main channel also spawn in the branch system, except the stenotopic rheophilous salmonids, the *Zingel* species and *Cottus gobio*. The growing fry populations can reach the main channel gradually still in juvenile stage.

In June or July the so-called "green flood" takes place. This is usually the highest one in Szigetköz. Many isolated water bodies become connected with the branch system only at this time. Certain species, usually characteristic to the main channel (e.g. *Barbus barbus, Chondrostoma nasus, Vimba vimba)*, have been found in the branch system in this period.

From September onwards, the water level becomes low or very low, creating separated marginal water bodies again. Rheophilous species may return to the main channel, where the water is clear by now and rich in oxygen.

The discrete sections isolated by transverse rock fills in the given side arm apparently look like an "ichthyological paradise". Although the species number is very high (often 30-35) along the short (some 10 meters long) bank, this is not due to the specific habitat. Only a few species *(Leuciscus cephalus, Rutilus rutilus, Lota lota, Gymnocephalus baloni, Perca fluviatilis, Proterorhinus marmoratus)* are constant fauna-elements of such places. The majority is made up of specimens isolated from the main channel. They just try to manage to survive until the next high water (sometimes half a year), many become weak and often fall prey to predators. Several of these perishing specimens are actually members of protected and/or endangered species, characteristic to the "sub-montane zone" *(Leuciscus leuciscus, Vimba vimba, Barbus barbus, Chondrostoma nasus, Alburnoides bipunctatus, Gobio kessleri, Gymnocephalus schraetzer)*.

Special water body types of the branch system are the permanent "inner lakes" of some islands. These communities are similar to the flood free area, although during high water conditions they are connected to the branch system. These water bodies serve as very good spawning sites for many species.

The total number of fish species in the branch system is 52.

Disconnected backwaters and marshlands of the flood free area

Before the great river regulation scheme for flood control and navigation has started in the last century, the side arms of the Danube were margined by extended marshlands and isolated water bodies. Nowadays there remains only a small fraction of this once extended world, and even this will probably be lost rather

soon because of drainage and meliorization. Its place is gradually taken over by intensive agriculture.

Backwaters can be found both in the flood plain and the flood free areas. Their water is usually rich in organic matter. Backwaters of the flood free area however, cannot refresh themselves with the flood water.

The largest backwaters of the flood free area are the ones near Lipót and Dunaszeg and the so called Zátonyi-Duna. Even these are gradually reduced by the accelerated ecological succession. Exceptions are the water bodies connected to irrigation canals. These sites have been studied thoroughly in the last 2-3 years, resulting in the discovery of *Umbra krameri*. The dominant accompanying species were *Misgurnus fossilis* and *Carassius carassius*. Further members of the fish community are *Proterorhinus marmoratus* and *Tinca tinca*. A rare species of such waters, *Leucaspius delineatus,* was found only twice (1989, by G. Guti, in the Cikola-branch system, and 1991, by A. Vida, in Zátonyi-Duna)

Umbra krameri is a strictly protected endemic species of the Danube catchment area. The water-regulations of the last century, the drainage of the marshlands eliminated many populations of this fish, yet it is not as endangered as *Hucho h. hucho*. It still can be found in many parts of the country, where suitable habitats are available. Therefore, it is the special habitat which should be protected. On the other hand, we do not know yet, how much of its genetic variation has been lost with the decreased population size. Genetic variance is necessary for survival, particularly in a changing environment. Since the European mud-minnow has a very much limited distribution (mainly within the Carpathian Basin), and even here exhibits a disjunct pattern, loss of genetic variance can be fatal for the species. At present this species appears to be not too rare in Szigetköz. After the discovery of the first specimen by Csányi in 1989 (Csányi, pers. comm.) it has turned up almost everywhere in the backwaters of the flood-free area. From the irrigation canals we could find it only once, near Hédervár. It is possible, that the species occurs also in the flood plain waters, although evidence for this is still missing.

The total number of fish species in the flood-free area's disconnected backwaters is 23.

Irrigation canals and water-supply

Regulation of the main channel affected the whole water-system of the Szigetköz. The thick layer of sand and gravel, which is the dominant substratum here, is highly permeable to water. Consequently, during high water in the flood-plain, water will raise in the flood protected area as well. Drainage was therefore constructed in this area resulting in a nearly 300 km long canal-system. Although existing former river beds were also used for the canals, the majority is a regularly cleaned strait-line canal. Therefore fish-faunistically interesting sites can be found only at natural or artificial barriers, such as bridges, trees thrown into the water, sharp turns of the canal, etc.

The most threatened species of this area is *Umbra krameri*. The total number of fish species is 27.

Ponds of gravel-pits

Gravel (ballast)-digging has long been a tradition in the Szigetköz, because of the good quality of the gravel. The groundwater fills up the abandoned pits sooner

or later. Such ponds can be found everywhere in the Szigetköz. Their fish fauna is the result of artificial introduction. The very minor fraction of fishes that has colonized these ponds naturally are usually cyprinids and thus these ponds are not unique by any means, so their fish fauna is not discussed here.

River branch "Mosoni-Duna"

Mosoni-Duna forms the S-SW boundary of the Szigetköz. It is a slow flowing water as compared to the main channel. The rivers Rába (Raab), Rábca and Lajta (Leitha) enters into this branch, strongly influencing the water level and the fish fauna.

Fishermen reported the occurrence of *Gasterosteus aculeatus* at the Halászi-bridge. From an area of 10 m^2 marginal water we subsequently could catch 50-80 specimens. Being a territorial-species such a population density is surprisingly high.

The first record of this species in Hungary was that published by Behyna (1938). The first voucher specimen was collected in 1956 from Budapest (Sterbetz 1957). Since that time, a few other catches were reported from the Danube in Verőcemaros, Vác and Ercsi (Botta *et al.* 1980, 1984). According to Berinkey (1966) this species was not introduced here but a native. On the contrary, Pintér (1989) is convinced, that the above mentioned specimens have actually been released near Vienna.

Intraspecific variation is quite considerable in *Gasterosteus aculeatus*. Pintér (1989) mentions only a single form from Hungary. We compared all preserved Hungarian specimens, which clearly belong to at least two forms. Thus, if they originate from an Austrian introduction, they must have come from two different ones.

Just like the connected backwaters (branch-system) of the flood plain, the Mosoni-Duna also receives water from the main river. Seasonal changes of the water level are also typical here, but the inflowing rivers (Rába, Rábca, Lajta) have an important effect as well. The branch is also connected with the irrigation canal-system, determining its fauna, too. The Mosoni-Duna branch is similarly rich in fish species (n=54) as the flood plain. According to some verbal communication, the extremely rare cyprinid *Pararutilus frissii meidingeri* might also occur at the end of the river branch. *Rutilus pigus virgo* surely lives in the outlets of the river.

Discussion

Fish diversity of the Szigetköz is higher than that of neighbouring areas (Holčik *et al.* 1981, Schiemer & Spindler 1989, see also Table 1). Several migratory species reproduce and develop fry in this area. The broad range in water quality (physical, chemical and biological) provides habitats for many ecologically specialized stenoecious species. All these conditions are responsible for the high species number of the Szigetköz (Table 2).

Comparing the number of fish species and the percentage of the protected or endangered species in the Szigetköz, to the fauna of the sub-montane region of the Raab River (the Raab flows into the Danube in Szigetköz, and is the largest river in the area with a sufficiently large sub-montane zone), it can be concluded that the Szigetköz fauna is more species-rich and possesses more unique species

than does the other area. The sub-montane zone of the Raab River above the city Körmend has been selected as sampling area, as the backwaters are located here and the entering Pinka River positively affects the fish fauna of the Raab. Besides, the irregulated area dominates this reach of the Raab River.

The faunistic richness revealed by Table 3 is mainly caused by the great diversity of habitats in the Szigetköz area, as in the sub-montane zone of the Raab only the main channel and the backwaters are included as water types. For some rare and migratory species (e.g. *Coregonus albula, C. lavaretus*) the main channel in the Szigetköz is of special importance as it falls into their migratory route.

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Table 1.

Species	DISTRIBUTION															C	P	Th
	S					H			Sl			A			R			
	1	2	3	4	5	1	2	3	1	2	3	1	2	3				
Petromyzontidae																		
Eudontomyzon mariae (Berg, 1931)	1	?	?	-	1	0-2	+	+	+	+	-	-	-	-	2	■		V
Acipenseridae																		
Acipenser ruthenus Linnaeus, 1758	1	1	-	-	1	0-2	+	?	+	+	-	1	-	-	?	■		E
Clupeidae																		
Caspialosa kessleri pontica (Eichwald, 1838)	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Anguillidae																		
Anguilla anguilla (Linnaeus, 1758)	1	1	-	-	1	0-3	+	+	+	+	-	1	1	1	1	■		I-V
Esocidae																		
Esox lucius Linnaeus, 1758	1	2	2	2	2	0-3	+	+	+	+	+	2	2	2	2	■		I-V
Umbridae																		
Umbra krameri Walbaum, 1792	-	?	1	2	-	0-2	-	-	+	?	-	-	-	-	-		■	V-E
Coregonidae																		
Coregonus albula Linnaeus, 1758	*	-	-	-	-	*	*	-	-	-	-	-	-	-	-			E
Coregonus lavaretus Linnaeus, 1758	*	-	-	-	-	*	*	-	?	+	-	-	-	-	-			E
Thymallidae																		
Thymallus thymallus (Linnaeus, 1758)	?	-	-	-	-	*	-	-	?	?	-	-	-	-	-			V
Salmonidae																		
Salmo trutta m. fario Linnaeus, 1758	1	1	-	-	-	0-3	*	+	+	?	-	-	-	-	1	■		V
Salmo gairdneri Richardson, 1833	1	-	-	-	-	0-3	*	+	+	+	-	-	-	-	1			
Hucho h. hucho Linnaeus, 1758	1	-	-	-	-	0-1	-	-	+	-	-	1	-	-	-		■	E
Cyprinidae																		
Cyprinus carpio Linnaeus, 1758	1	2	1	1	2	0-3	+	+	+	+	+	1	2	2	2	■		V-E
Cyprinus carpio m. hungaricus (Heckel, 1843)	1	1	-	-	?	0-1	+	?							1	■		
Abramis brama (Linnaeus, 1758)	2	2	-	-	2	0-3	+	+	+	+	+	3	3	3	2	■		
Abramis ballerus (Linnaeus, 1758)	1	2	-	-	1	0-2	+	+	+	+	+	2	3	3	1	■		V
Abramis sapa (Linnaeus, 1758)	1	1	-	-	1	0-2	+	+	+	+	-	1	2	2	1	■		R-V
Alburnus alburnus (Linnaeus, 1758)	3	3	1	1	3	0-3	+	+	+	+	+	3	3	3	3	■		I
Alburnoides bipunctatus (Bloch, 1782)	1	-	-	-	1	0-3	-	+	+	+	-	-	1	-	3	■	■	V-E
Aspius aspius (Linnaeus, 1758)	2	2	-	-	1	0-2	+	+	+	+	+	2	2	-	2	■		V-E
Barbus barbus (Linnaeus, 1758)	3	2	-	-	2	0-3	+	+	+	+	-	3	1	-	3	■		V
Blicca bjoerkna (Linnaeus, 1758)	3	3	2	-	3	0-3	+	+	+	+	+	3	3	3	3	■		I
Carassius carassius (Linnaeus, 1758)	-	1	1	2	1	0-3	+	+	+	+	+	-	-	1	1	■		R-V
Carassius auratus (Linnaeus, 1758)	2	3	1	1	3	0-3	+	+	+	+	?	2	1	1	2	■		I
Chalcalburnus chalcoides mento (Agassiz, 1832)	?	-	-	-	1	0-1	*	-	-	-	-	-	-	-	-		■	V-E
Chondrostoma nasus (Linnaeus, 1758)	3	2	-	-	2	0-3	+	+	+	+	+	3	3	-	3	■		I-V
Ctenopharyngodon idella (Valenciennes, 1844)	1	1	1	1	2	0-2	+	-	+	+	+	-	1	1	1	■		
Gobio albipinnatus Lukasch, 1933	2	2	3	-	2	0-3	+	+	+	+	-	3	1	-	3	■		R
Gobio gobio (Linnaeus, 1758)	2	2	3	1	2	0-3	+	+	+	+	+	1	-	-	3	■		I-R
Gobio kessleri Dybowski, 1862	1	1	-	-	1	0-3	+	+	+	+	-	1	-	-	2	■		R-V
Hypophthalmichthys molitrix (Valenciennes, 1844)	1	2	-	-	1	0-2	+	+	+	?	-	-	1	-	1	■		
Hypophthalmichthys nobilis (Richardson, 1845)	1	2	-	-	1	0-2	+	+	+	+	-	-	1	-	1	■		
Leucaspius delineatus (Heckel, 1843)	-	1	?	2	-	0-3	?	+	+	+	+	-	-	2	1	■		R-V
Leuciscus cephalus (Linnaeus, 1758)	3	3	3	1	3	0-3	+	+	+	+	+	3	2	1	3	■		
Leuciscus idus (Linnaeus, 1758)	1	2	1	1	2	0-3	+	+	+	+	+	2	1	-	1	■		V-E

Table 1. Distribution of fishes in the Szigetköz as compared to neighbouring water bodies, their nature conservation status, and representation in our collection

Table 1. cont.

Species	DISTRIBUTION														C	P	Th
	Sz					H			Sl			A			R			
	1	2	3	4	5	1	2	3	1	2	3	1	2	3				
Phoxinus phoxinus (Linnaeus, 1758)	1	-	-	-	1	0-3	*	+	+	-	-	-	-	-	1			V
Pseudorasbora parva (Temminck et Schlegel, 1842)	1	1	1	1	1	1	3	+	+	+	?	-	-	-	2			
Rhodeus sericeus amarus (Bloch, 1782)	2	2	3	1	2	0-3	+	+	+	+	+	-	1	3	2			R-V
Rutilus rutilus (Linnaeus, 1758)	3	3	3	2	3	1	3	+	+	+	+	2	3	3	2			
Rutilus pigus virgo (Heckel, 1852)	1	1	-	-	1	0-1	+	+	+	+	-	1	-	-	?			R
Pararutilus frisii meidingeri (Heckel, 1852)	?	-	-	-	1	0-?	-	-	+	-	-	-	-	-	-			R-E
Scardinius erythrophthalmus (Linnaeus, 1758)	-	1	1	2	2	0-3	+	+	+	+	+	-	1	3	1			V
Tinca tinca (Linnaeus, 1758)	1	1	1	2	2	0-3	+	+	+	+	+	-	1	2	1			I
Vimba vimba (Linnaeus, 1758)	2	2	-	-	1	0-3	+	+	+	+	-	1	1	-	1			I-E
Cobitidae																		
Cobitis taenia Linnaeus, 1758	1	2	3	1	2	0-3	+	+	+	+	+	-	1	1	2			R
Cobitis aurata (Filippi, 1865)	?	1	-	-	1	0-2	+	+	+	+	-	-	-	-	2			R-V
Misgurnus fossilis (Linnaeus, 1758)	-	1	2	2	1	0-3	+	+	+	+	+	-	-	-	1			R-V
Noemacheilus barbatulus (Linnaeus, 1758)	2	2	2	1	2	1	3	+	+	+	-	-	-	-	2			R-V
Ictaluridae																		
Ictalurus nebulosus (Le Sueur, 1819)	-	1	1	-	2	0-3	+	+	+	+	+	-	-	-	1			
Siluridae																		
Silurus glanis Linnaeus, 1758	1	1	-	-	1	0-2	+	+	+	+	+	1	1	1	2			R-V
Gadidae																		
Lota lota (Linnaeus, 1758)	2	2	-	-	1	0-2	+	+	+	+	+	1	1	-	2			R-I
Gasterosteidae																		
Gasterosteus aculeatus Linnaeus, 1758	-	-	-	?	3	0-1	+	-	?	+	-	1	-	-	-			I-R-V
Cottidae																		
Cottus gobio Linnaeus, 1758	3	1	-	-	-	0-?	?	-	+	+	-	2	1	-	-			V
Centrarchidae																		
Lepomis gibbosus (Linnaeus, 1758)	-	1	2	2	2	0-3	+	+	+	+	+	-	-	3	1			
Percidae																		
Perca fluviatilis Linnaeus, 1758	2	3	2	2	3	1	3	+	+	+	+	2	2	3	2			
Gymnocephalus baloni Holcik et Hensel, 1974	2	3	-	-	-	0-2	+	?	+	+	-	1	1	-	-			V
Gymnocephalus cernuus (Linnaeus, 1758)	2	2	-	-	1	0-3	+	+	?	+	+	1	2	2	1			I
Gymnocephalus schraetzer (Linnaeus, 1758)	2	1	-	-	1	0-2	+	+	+	+	-	1	1	-	2			E
Stizostedion lucioperca (Linnaeus, 1758)	2	2	-	-	2	0-3	+	+	+	+	+	2	2	2	2			I-V
Stizostedion volgense (Gmelin, 1788)	1	2	-	-	1	0-3	+	+	+	+	+	1	1	-	1			I-V
Zingel zingel (Linnaeus, 1758)	1	-	-	-	1	0-2	+	+	+	?	-	1	-	-	2			E
Zingel streber (Linnaeus, 1758)	1	-	-	-	1	0-2	+	+	+	+	-	1	-	-	2			E
Gobiidae																		
Proterorhinus marmoratus (Pallas, 1811)	2	3	3	2	3	1	3	+	+	+	+	1	2	3	-			V

Table 1 – continued

Legend: Sz = Szigetköz: 1 = main channel, 2 = side-arm systems, 3 = irrigation canals, 4 = disconnected backwaters, 5 = Mosoni-Duna. H = Hungary: 1 = other parts of the country, 2 = Danube river, 3 = catchment area of the Danube in the Szigetköz. Sl = Slovakian Danube reach (after Holčik *et al.* 1981): 1 = main channel, 2 = side-arm systems, 3 = biotopes outside the floodplain. A: Austrian Danube reach between Vienna and the Slovakian border (after Schiemer & Spindler 1989): 1 = main channel, 2 = connected backwaters, 3 = disconnected backwaters. R = Submontane zone of the Hungarian part of the Raab river. C = collected in the Szigetköz (1983–1993). P = protected by the law in Hungary. Th = threatened in Europe (after Lelek 1987). Symbols: - = absent, + = unspecified, ? = assumed occurrence, * = random occurrence, 1 = rare, 2 = common, 3 = abundant

Table 2.

Comparative ichthyofaunistic analysis of the main water types in Szigetköz
(*The categories are used after Lelek 1987)

Water types in Szigetköz	Total number of fish species	Number of nationally protected species	Number of threatened species* (endangered, rare, vulnerable)	Number of species endangered in Europe*
Main channel	57	13 (23%)	41 (72%)	14 (25%)
Flood plain backwaters	52	10 (19%)	36 (69%)	7 (13%)
Irrigation canals	27	7 (27%)	16 (59%)	3 (11%)
Disconnected backwaters	23	6 (26%)	14 (61%)	3 (13%)
Mosoni-Duna	54	13 (24%)	38 (70%)	11 (20%)

Table 3.

Comparative ichthyofaunistic analysis of the two submontane-zones (Szigetköz and Rába river, above Körmend)
(*The categories are used after Lelek 1987)

Submontane-zone, all water types	Total number of fish species	Number of nationally protected species	Number of threatened species* (endangered, rare, vulnerable)	Number of species endangered in Europe*
Szigetköz	65	16 (25%)	47 (82%)	14 (22%)
Rába	53	9 (17%)	36 (68%)	7 (13%)